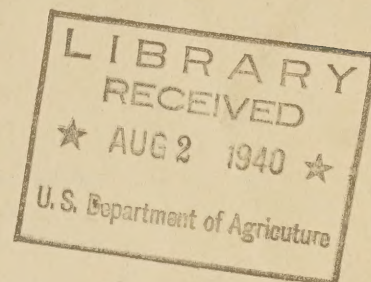


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MECHANIZATION AND THE USE OF LABOR ON FARMS

U.S.
Tables and Charts Presented by Sherman E. Johnson,
and R. S. Kifer, Division of Farm Management and Costs,
Bureau of Agricultural Economics, at the Hearings Before
the Civil Liberties Committee, May 10, 1940.



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THE USE OF MACHINERY AND LABOR ON FARMS

The use of equipment and mechanical power on farms in the United States has tremendously increased efficiency in the use of farm labor. The saving in time on farm work resulting from the use of tractors, tractor equipment, motortrucks, and electrical devices has reduced the need for workers particularly in some lines of production and in some areas. For instance in 1880, about 17 hours were expended in producing an acre of wheat and 129 hours were expended per 100 bushels of grain. In 1930 the average labor expended was nearer 7 hours per acre and 49 hours per 100 bushels. In that 50-year period changes in methods of growing and harvesting corn reduced the amount of labor required for corn production about 20 hours per acre and 76 hours per 100 bushels. We usually consider that the methods of producing cotton have not changed but the time spent on cotton decreased about 34 hours per acre and 69 hours per bale in the same 50-year period.

Not all of this change can be attributed to mechanization as we know it today. The shifting of producing areas into the prairie sections, and the use of large scale horse-drawn equipment was effective in reducing labor before tractors came into use. So long as the agricultural industry was expanding the numbers employed were not particularly affected by labor-saving devices, but when the industry ceased to expand, excess farm population became more serious. Agriculture in 1939 probably employed 500,000 fewer people than in 1930 and the end is not yet. The use of known techniques will release many more workers and we have no reason to expect that technical improvement will not continue.

The following exhibits show the influence of mechanization on the use of labor on farms and provide a basis for anticipating further changes.

Tractor Use Increases Steadily

Development of the standard tractor changed the method of doing work in the small grain producing areas. Tractor numbers on farms increased from an insignificant number in 1915 to about 900,000 in 1930. These were mostly either the standard type or crawler tractors. Some standard tractors were used in the Corn Belt particularly on the large farms, but with the development of the general purpose tractor, and especially with the addition of pneumatic tires, the use of tractors and mechanical equipment increased rapidly in the Corn Belt and in the Eastern States. About 85 percent of the tractors sold in the United States in 1939 were general purpose tractors and nearly all of these were equipped with rubber tires. Probably about 1,600,000 tractors were on farms in 1939. Further improvements in the design of tractors and the adaptation of tractors to a wider variety of uses will further increase their usefulness. If the small tractor proves to be economical in the Eastern and Southeastern States tractor numbers might increase markedly in the next 10 years.

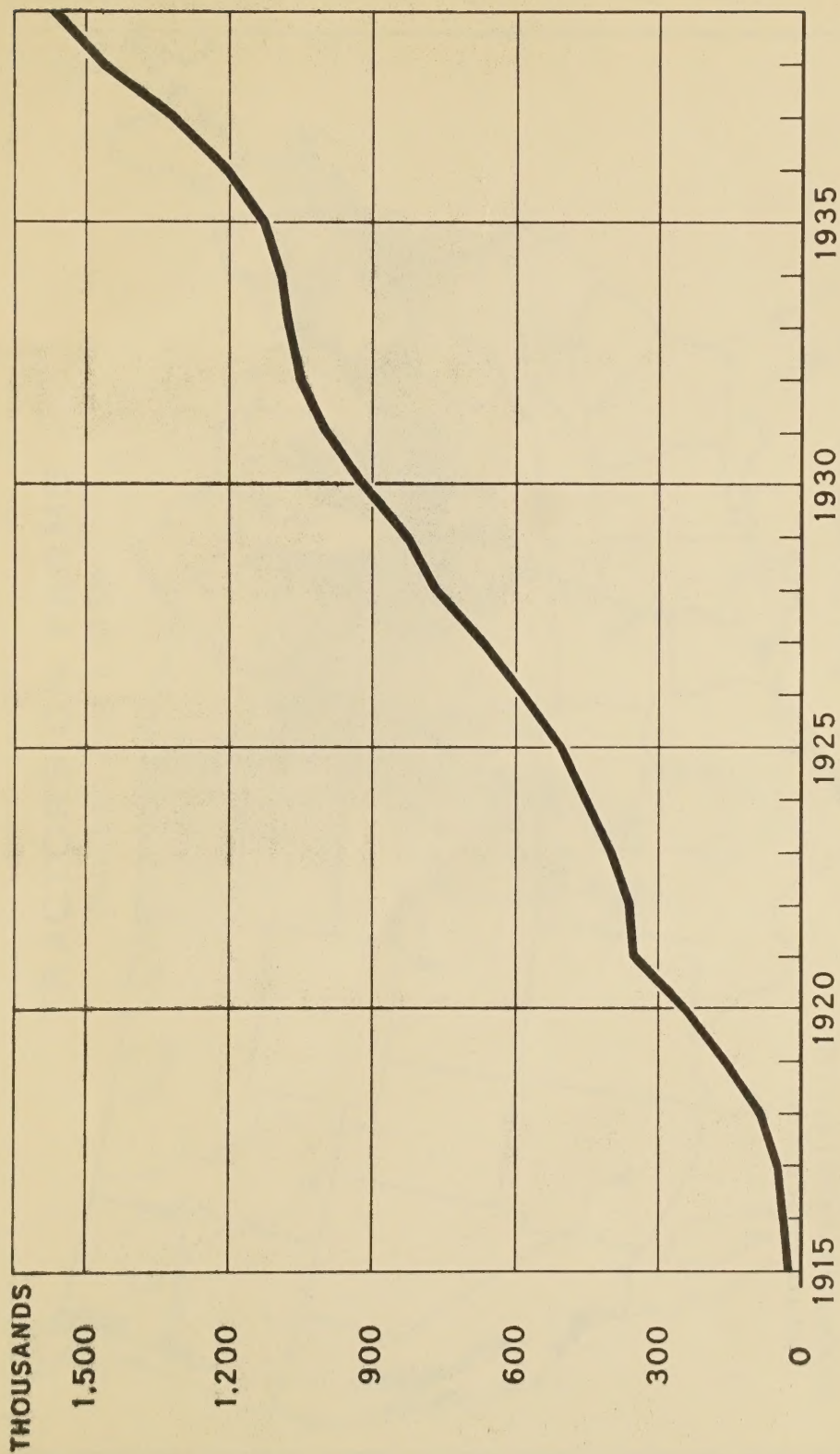
The effectiveness of tractors in labor displacement is partly the result of speeding up the rate of doing the work because of more power and greater speed, but perhaps more important is the use of new machines especially adapted for tractors.

Small tractors and equipment for farms with a relatively small crop acreage have extended the influence of mechanization to general farming areas and other areas of small farms. In 1939 (table 1), 98,000 tractor-drawn moldboard plows were sold in the United States. Sixty-five percent of these were 2-bottom plows and 24 percent were 1-bottom plows. The bulk of sales was in the smaller sizes. Of 70,000 tractor-drawn cultivators, 66,000 were of 2-row size. A small proportion of the tillage implements was of the large sizes.

Harvesting equipment has been effective in displacing labor. Sales of grain combines exceeded sales of binders. Small combines, with a working width of 6 feet or less, made up 80 percent of sales in 1929. This indicates an increasing use of combines in areas where acreages are smaller than in the small-grain producing States. Corn picker sales exceeded sales of corn binders.

Source of data: Estimates 1915-24 except 1920 from Jones, Fred R., Farm Gas Engines and Tractors; 1920 and 1930 from U. S. Census; 1925-37 from estimates of Farm Equipment Institute as reported in report A-9, National Research Project of Works Progress Administration; 1938-39 from Farm Implement News, July 8, 1939.

TRACTORS (ALL TYPES); NUMBER ON FARMS, JAN. 1, 1915 - JAN. 1, 1939



U. S. DEPARTMENT OF AGRICULTURE

NEG. 35352

BUREAU OF AGRICULTURAL ECONOMICS

TRACTORS ON FARMS

Number, July 1, 1938

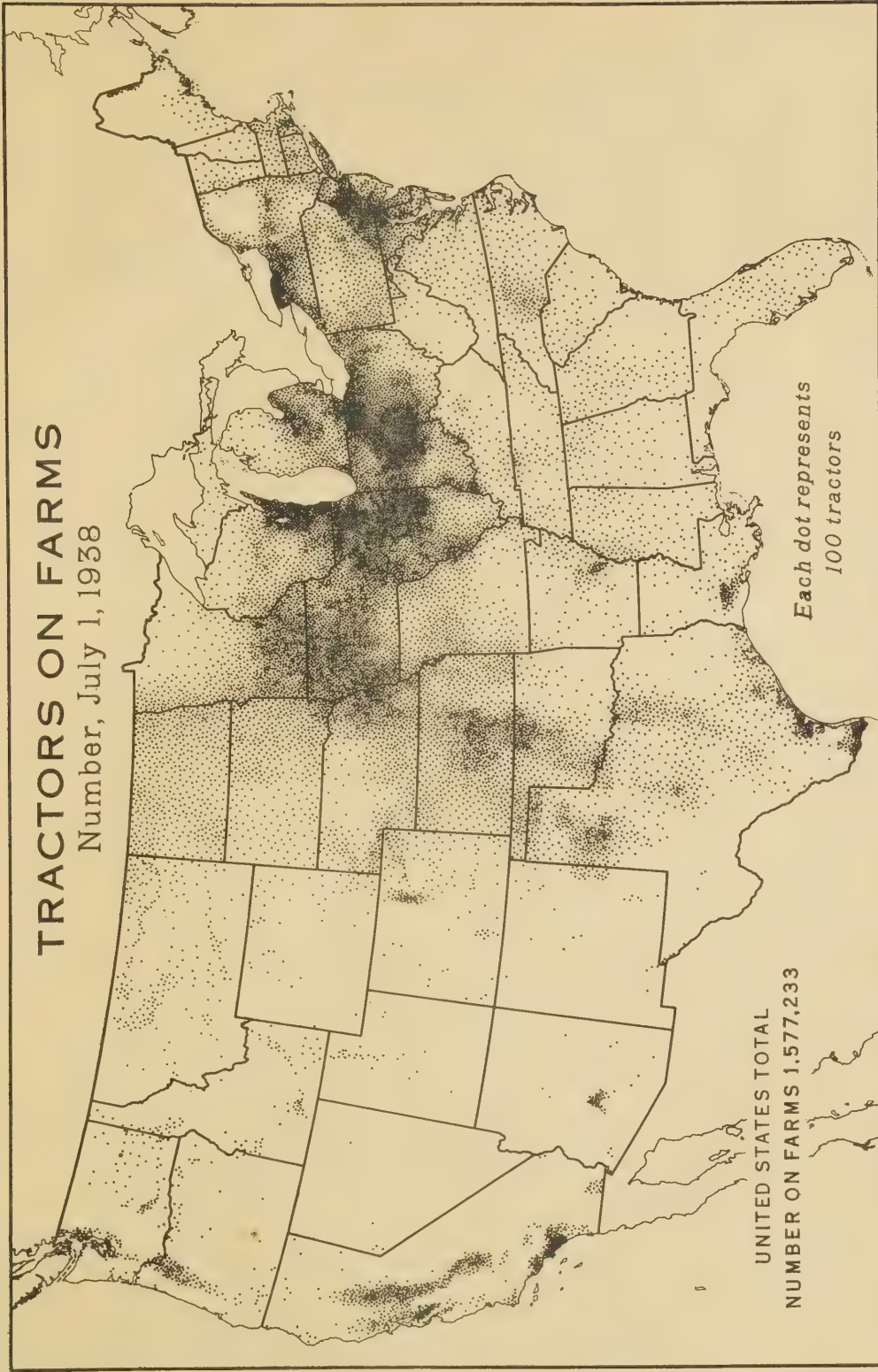


Table 1. Sales of Selected Types of Farm Equipment for
Use in the United States, 1923-1939

Year	Tractors		Combines		Grain	Corn	Tractor-drawn	Tractor mold-
	All types	General	all	Grain	binders	nickers	cultivators	board plows
	purpose	sizes	binders	nickers	cultivators	board plows		
	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands
1923.	115		1	40				54
1924.	97		2	19				41
1925.	119		4	35			2	54
1926.	123		6	47			6	66
1927.	156		11	53	77		7	71
1928.	100		18	48	8		13	80
1929.	155		20	-	10		25	91
1930.	128		17	31	10		41	84
1/								
1935.	133	95	5	53	4		53	56
1936.	179	133	14	35	5		101	110
1937.	238	184	28	52	14		126	140
1938.	164	129	42	31	14		88	107
1939.	171	147	31	15	11		70	98

Data from U. S. Department of Commerce, Bureau of the Census
Manufacture and Sale of Farm Equipment and Related Products.

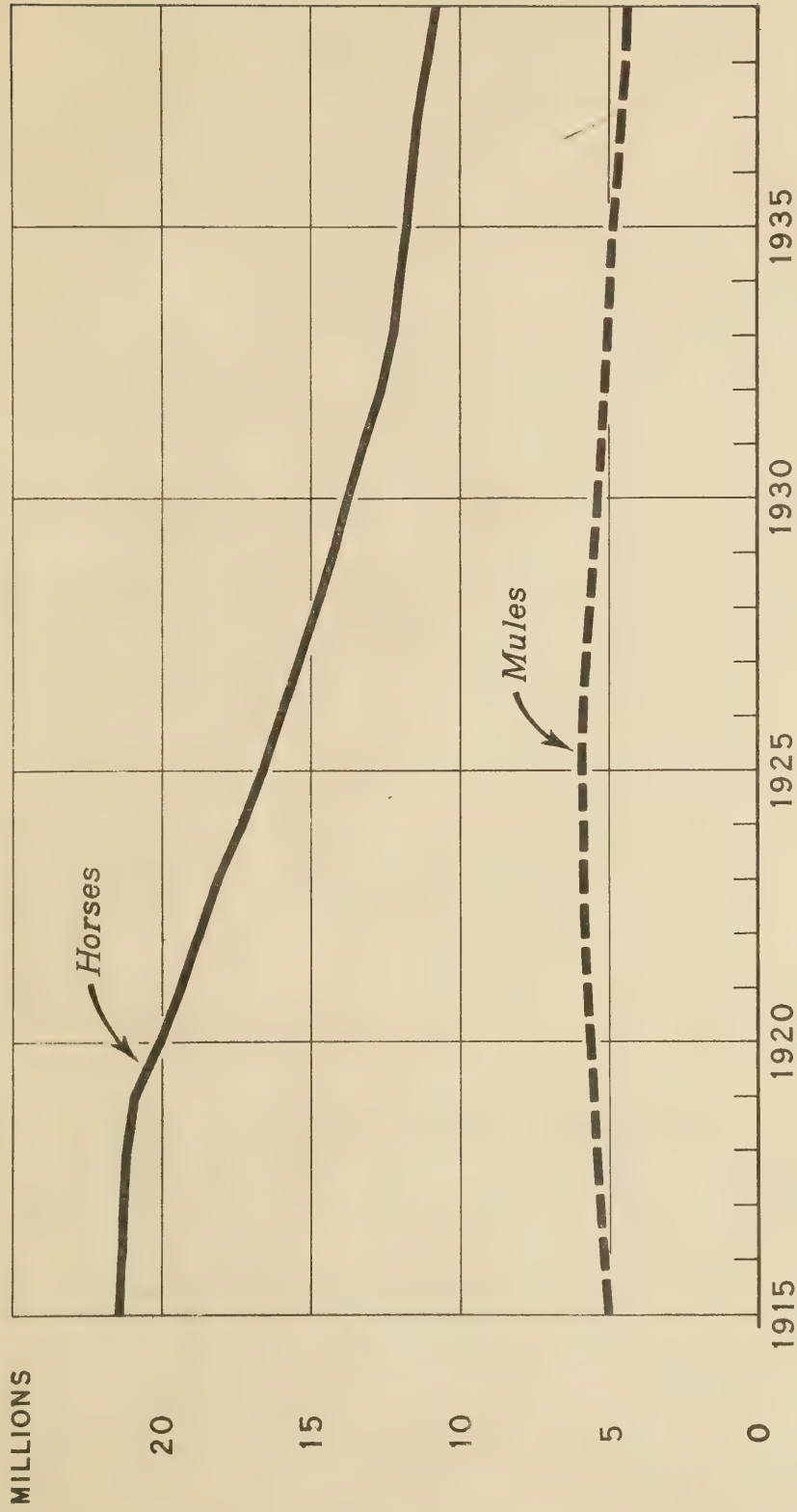
1/ Reports 1931-1934 not available.

Horses and Mules on Farms Decrease

The use of tractors reduces the need for horses and mules on farms and, through a decrease in the numbers of work stock, has a marked effect upon the agricultural produce available for sale, and also upon the financial organization of the farms. Before tractors came into general use 25 million horses and mules were reported on farms in the United States. Since 1920 this number has gradually decreased until only 15 million were reported in 1939. Approximately 50 million acres of crop and pasture land needed for horse feed in 1920 are now available for other purposes. The displacement of work stock on farms should not be attributed wholly to the use of tractors. The use of automobiles on farms, which increased until about 1930, and the use of trucks for hauling, were as effective as tractors in reducing horse and mule numbers. Although the number of trucks on farms has not increased greatly in the last few years, commercial hauling by trucks has further reduced the need for work animals on farms.

At the present rate of work stock reproduction it seems that horse and mule numbers will be stabilized at about 12,500,000 head. However, the recent introduction of the small 1-plow tractor may reduce the need for horses still further.

HORSES AND MULES; NUMBER ON FARMS, JAN. 1, 1915 - JAN. 1, 1939

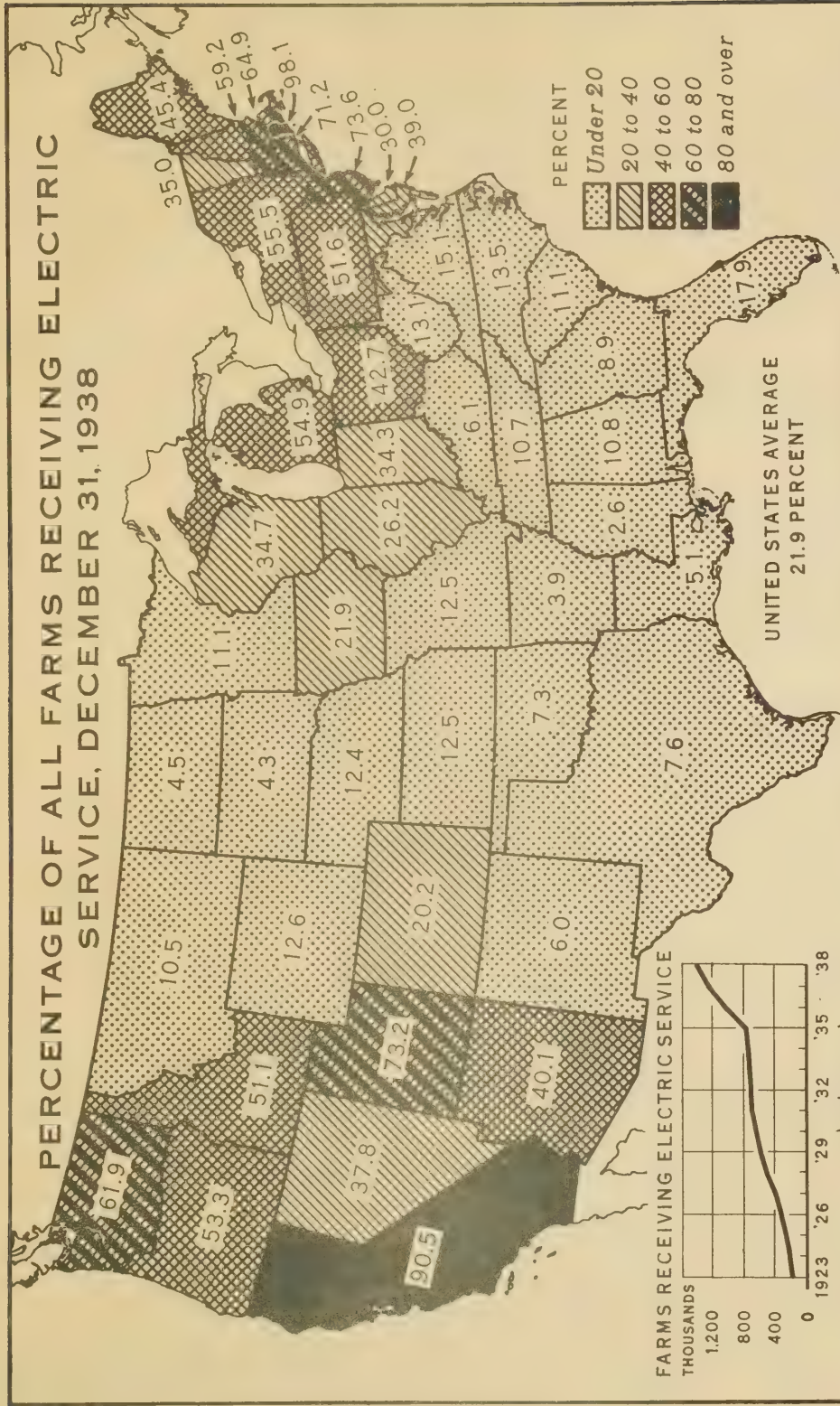


Rural Electrification

Rural electrification is spreading rapidly in the United States particularly in the Western, Northeastern, and North Central States. The influence on labor used in production is less striking than in the case of tractors and tillage equipment, but electric motors on the farms do increase the amount of work a man can do. Such operations as pumping water for irrigation or stock use, feed grinding, elevating grain, operating mechanical milkers facilitate many details of work on farms. The influence on labor may be that of performing unpleasant jobs for the farmer but as the work that can be done per man increases there is less need for family or hired labor.

Farms receiving power line service increased from 100,000 in 1920 to approximately 1,400,000 in 1938.

PERCENTAGE OF ALL FARMS RECEIVING ELECTRIC SERVICE, DECEMBER 31, 1938



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Per Acre to Produce Wheat and Oats by
at Different Periods 1909-36

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included in the areas used in the charts of
labor used on crops are:

New Hampshire, Vermont, Massachusetts, Connecticut,
New York, Pennsylvania.

Michigan, Wisconsin, Minnesota.

diana, Illinois, Iowa, Missouri.

Maryland, Virginia, North Carolina, Kentucky,
Tennessee.

South Carolina, Georgia, Alabama.

Mississippi, Arkansas, Louisiana.

Oklahoma, Texas.

ntana, North Dakota, South Dakota, Nebraska,
Kansas.

Colorado, Utah, Nevada, New Mexico, Arizona.

daho, Washington, Oregon.

lifornia.

uded are: Maine, Rhode Island, New Jersey,
Delaware, Florida.

-10, Changes in Technology and Labor Requirements
t and Oats, National Research Project of Works
pp. 95 and 98.

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Labor Used Per Acre to Produce Wheat and Oats by
Areas at Different Periods 1909-36

Wheat was produced in the United States in 1936 with approximately one-half the labor used per acre in 1909. The use of tractors and tractor equipment and the shifting of wheat production to areas adapted to the use of large scale equipment reduced the use of labor to grow and harvest wheat from 12.7 hours per acre in 1909 to 6.1 hours in 1936. The most striking reductions in the use of labor are in such specialized areas as the small grain, range, and western cotton areas where the labor requirements were reported as 3 or 4 hours per acre and 0.3 to 0.4 hour per bushel.

The combine-harvester has been a spectacular development in wheat production, but tractor use, and large tillage and seeding equipment contributed to the reduction in labor required and the increase in acreage handled per man.

In the eastern areas and in the Corn Belt more labor per acre was used in 1936 than was used in the small grain areas even in 1909. Many farmers still used the older types of equipment and mechanization proceeded more slowly than it did in the small grain areas. Usually there is only a small acreage of wheat grown per farm. The use of small combines will probably reduce labor on small grains in these areas.

On the average the time used to produce an acre of oats in the United States dropped from 12.5 hours in 1909 to 7.9 hours in 1936. With the decrease in horse numbers oat acreage declined from 44,000,000 acres in 1925 to 33,000,000 acres in 1939.

Chart Legend: A=1909-13, B=1917-21, C=1927-31, D=1934-36.

Note: The States included in the areas used in the charts of changes in labor used on crops are:

Eastern Dairy: New Hampshire, Vermont, Massachusetts, Connecticut,
New York, Pennsylvania.

Western Dairy: Michigan, Wisconsin, Minnesota.

Corn: Ohio, Indiana, Illinois, Iowa, Missouri.

Middle Eastern: Maryland, Virginia, North Carolina, Kentucky,
Tennessee.

Eastern Cotton: South Carolina, Georgia, Alabama.

Delta Cotton: Mississippi, Arkansas, Louisiana.

Western Cotton: Oklahoma, Texas.

Small Grain: Montana, North Dakota, South Dakota, Nebraska,
Kansas.

Range: Wyoming, Colorado, Utah, Nevada, New Mexico, Arizona.

Northwestern: Idaho, Washington, Oregon.

California: California.

States not included are: Maine, Rhode Island, New Jersey,
Delaware, Florida.

Figure -- LABOR USED IN PRODUCING WHEAT, BY AREA, 1909-36

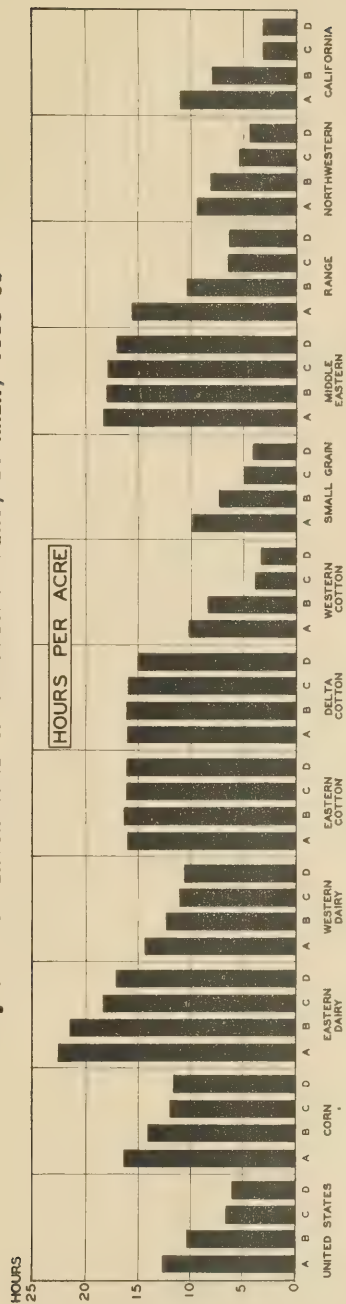
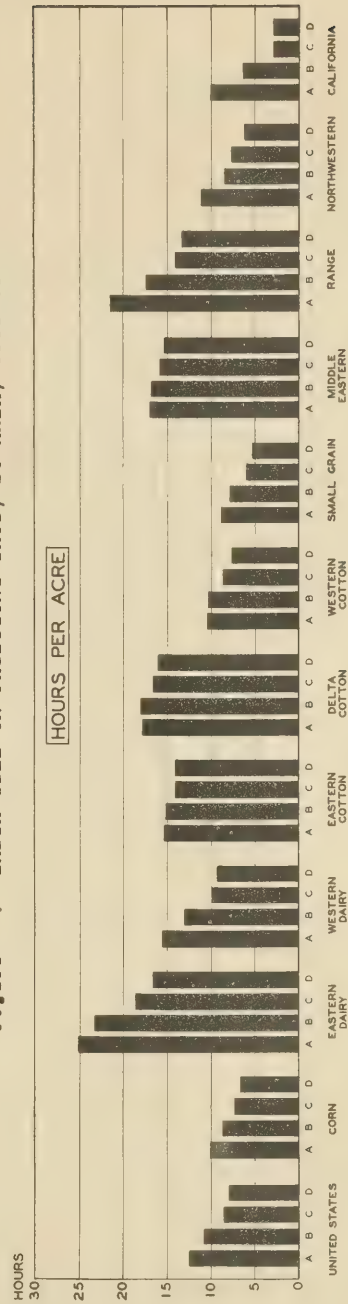


Figure -- LABOR USED IN PRODUCING OATS, BY AREA, 1909-36



Labor Used Per Acre to Produce Corn and Cotton
by Areas at Different Periods 1909-36

The labor used per acre for corn production did not show as marked a decrease for the period 1909 to 1936 as has been shown for wheat production. Mechanization has progressed rather slowly in most corn producing areas, and it was not until the rubber-tired, general purpose tractor was put on the market that drastic changes in labor requirements were reported in important corn producing areas. However, the labor per acre on corn decreased from about 29 hours in 1909 to about 23 hours in 1936. A part of this decrease is due to the use of corn pickers in the Corn Belt, but probably more resulted from the use of tractors and multi-row equipment. A continuance of mechanization in the Corn Belt and in the Eastern States indicates that reductions in the use of labor on corn will continue.

Developments in machinery for cotton production are not comparable to those for wheat or corn. Most cotton is still picked by hand. The decrease in labor requirements of cotton of from about 105 hours per acre in 1909 to about 88 hours per acre in 1936 was partly due to the shifting of cotton acreage from areas in the eastern part of the United States, where a large amount of hand labor is required, to western areas, where the field labor up to picking time can be done with larger machinery and where less hand chopping is necessary. Hand picking is still the rule, but the development of an acceptable cotton picker would mean a revolution in cotton production comparable to that which has already taken place in wheat production. Many more workers would be displaced because the shift would be directly from hand labor to machine work, whereas in wheat production the shift has involved only the use of more efficient machines.

Note: Cotton areas left to right, United States, Eastern Area, Delta Area, Western Area. Periods 1909-11, 1917-21, 1927-31, 1933-36.

Source of data: Report A-7, Cotton, and Report A-5, Corn. Changes in Technology and Labor Requirements for Crop Production. National Research Project, Works Progress Administration.

Figure - LABOR USED PER ACRE
PRODUCING COTTON IN MAJOR AREAS
1907-11 to 1933-36

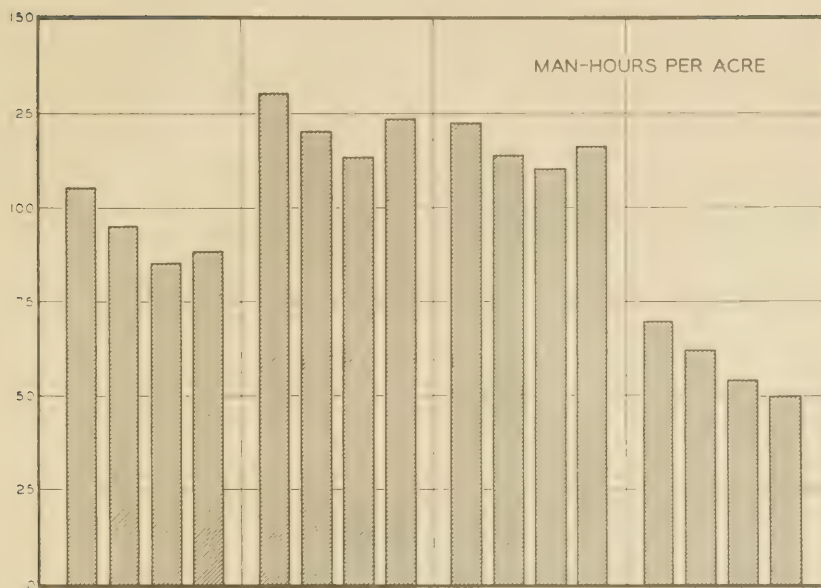
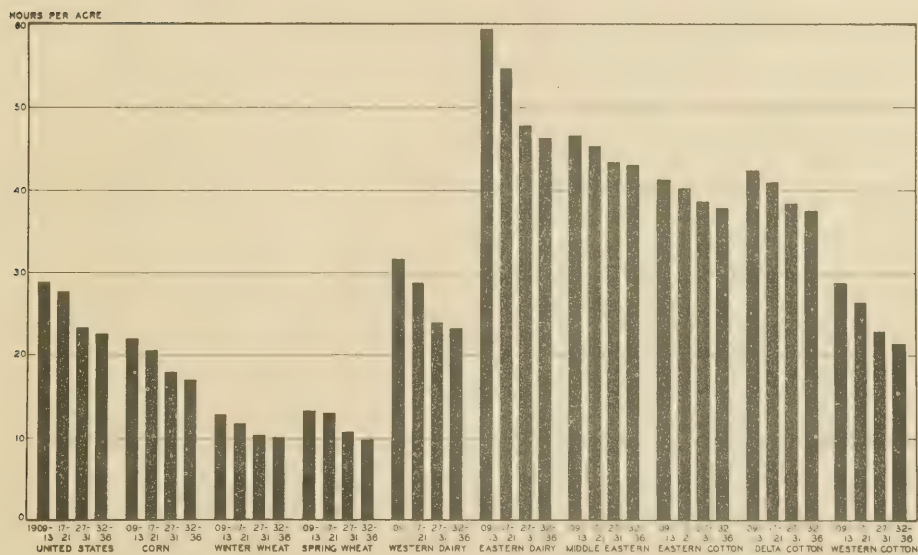


Figure - VARIATIONS BY AREAS IN LABOR USED PER ACRE IN
PRODUCING CORN, 1909-36



See table 44 for data.

WPA - National Research Project

Labor Used Per Acre to Produce Potatoes by
Selected Areas at Different Periods 1909-36

The use of tractors, large tillage equipment, power sprayers, and diggers has reduced labor to grow and market potatoes since 1909 by 14 hours per acre in Arcostock County, Maine. Yields were increased nearly 90 bushels per acre so that the time to produce and market 100 bushels of potatoes in 1936 was only 60 percent of that required in 1909. Whereas more efficient machine methods reduced labor, the time required to combat insects and diseases increased in some areas. Significant reductions in the labor used were made in the digging and marketing operations.

Source of data: Report A-4, Changes in Technology and Labor Requirements in Crop Production, National Research Project, Works Progress Administration.

Some of the most striking examples of labor-saving equipment are those used on relatively minor crops. Although these types of equipment - the cane stripper, the pick-up baler, the field ensilage cutter, the mechanical beet blocker, etc. - have not been used on large acreages, they do have an actual or a potential influence on labor requirements in particular sections of the United States. The Bureau of the Census reported 440 ensilage harvesters, 410 hay press combines, 1,652 beet lifters sold in 1939. Some of the other types of machines are being developed.

Efficiency in the Use of Labor on Farms in Relation to
the Size of the Agricultural Enterprise

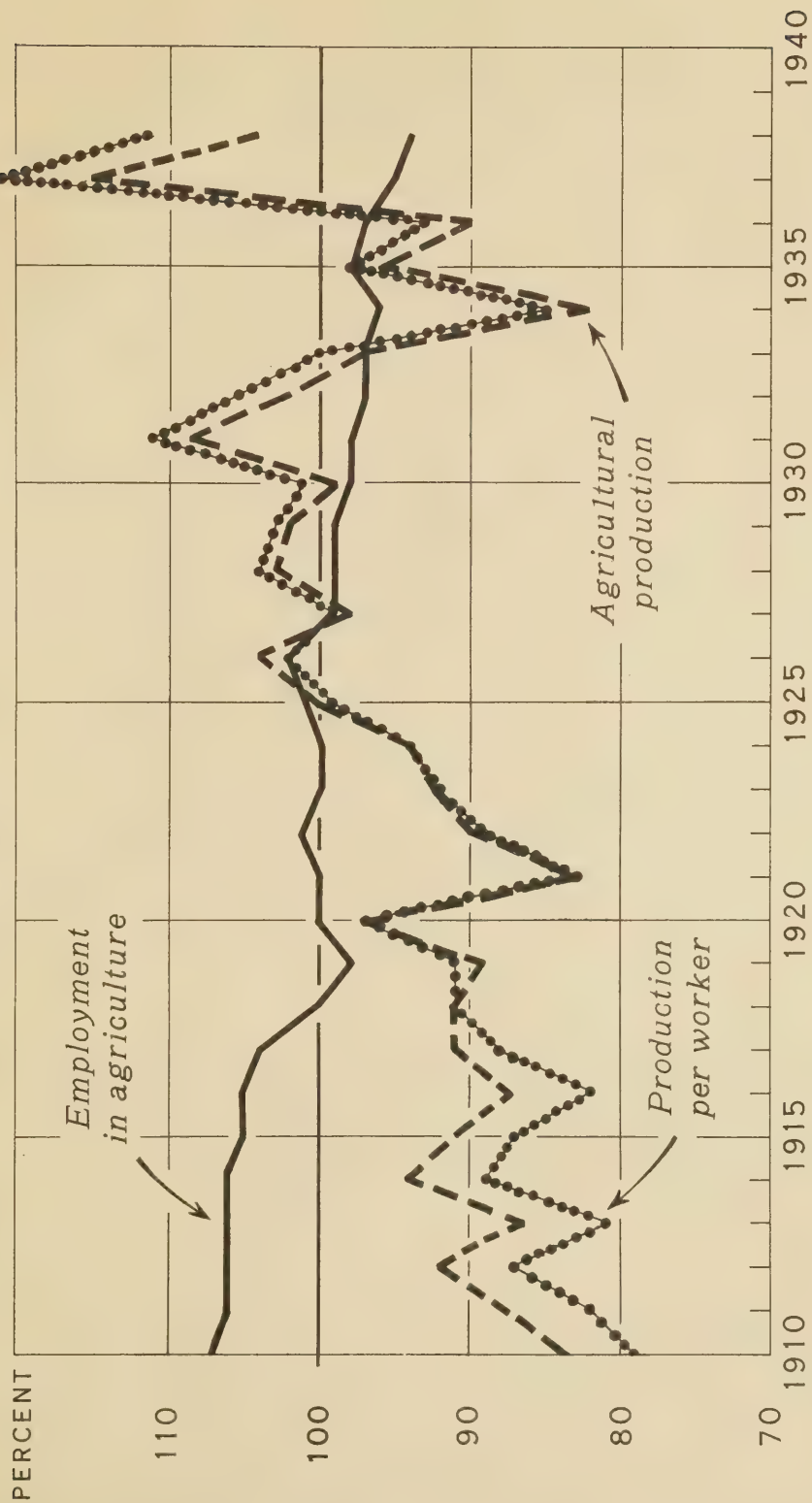
Mechanical developments have increased the efficiency of farm labor in terms of output per worker and therefore decreased the need for labor on farms. Reported employment in agriculture has been declining since 1926. The index of the size of the aggregate agricultural enterprise shows an increase in the farm plant until after 1932. An expanding agriculture from 1910 until 1920 cushioned the shock to workers displaced through the use of equipment. Since 1932, however, because of extensive drought which resulted in crop failures over large portions of the United States and partly as a result of acreage adjustment programs, the size of the total farm business was smaller in 1936-39 than it was in 1930. This decrease in the size of aggregate farm enterprise is reflected chiefly in the harvested acreage of wheat, cotton, and corn. The ratio of the index of size of the aggregate farm enterprise and the index of employment indicates, however, that the efficiency of labor has been increasing and that fewer individuals were required in 1938 to care for a farm enterprise larger than in 1910.

Note: The index of the size of the agricultural enterprise was constructed by weighting the acreage of crops harvested each year and the number of livestock reported each year by the average labor requirements per unit for each crop and class of livestock as reported for the base period 1924-29.

Source of data: Series 1910-36, National Research Project of Works Progress Administration.

RELATION OF EMPLOYMENT IN AGRICULTURE TO AGRICULTURAL PRODUCTION

INDEX NUMBERS (1924-29=100)



Efficiency of Labor in Terms of Production

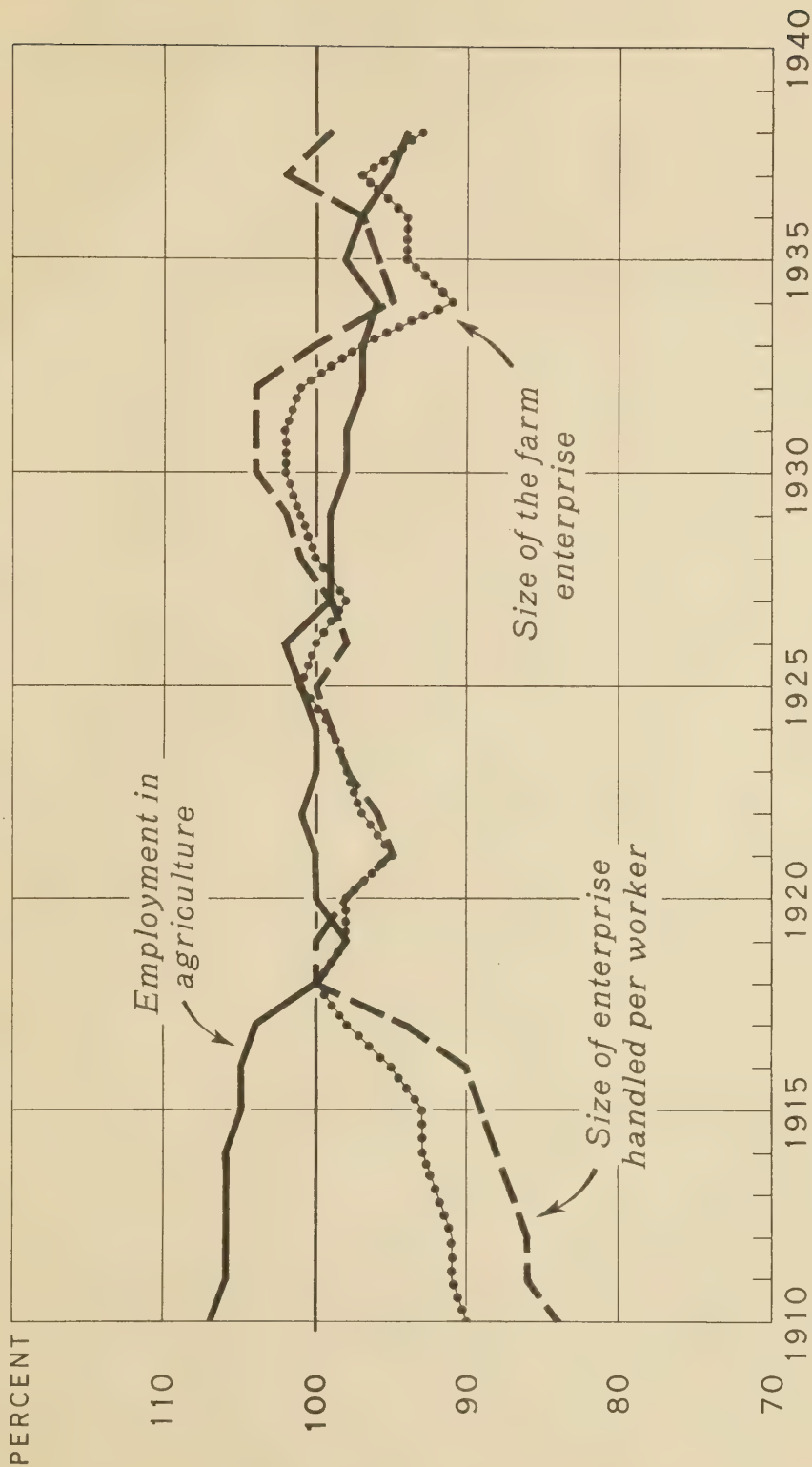
The effectiveness of labor in terms of production has increased more rapidly than in terms of crop acres and numbers of livestock. The output per farm worker increased from 79 percent of the 1924-29 base in 1910 to 112 percent in 1938. Crop failure - the result of widespread drought - reduced the volume of product in 1934 and 1936. Total employment has decreased continuously since 1935. The number of hired workers dropped from 2,850,000 in 1930 to 2,346,000 in 1934. In 1938 the volume of production recovered but only 2,529,000 hired workers were reported. The index of volume of production stood at 105 in 1939 but the index of hired workers was only 85. Greater efficiency in the production of farm products and more effective use of labor tend to decrease the volume of employment in agriculture and to decrease opportunities for reemployment within agriculture of the labor displaced by mechanization.

Note: The index of agricultural production is calculated by weighting the volume of the different farm commodities produced each year by the labor required per unit of production during the base period 1924-29. Employment figures are the average of the numbers employed the first of each month.

Source: Data from National Research Project, Works Progress Administration, and from the Agricultural Marketing Service, U.S.D.A.

RELATION OF EMPLOYMENT IN AGRICULTURE TO THE SIZE OF AGRICULTURAL ENTERPRISE

INDEX NUMBERS (1924-29=100)



Changes in Labor Used in Particular Areas

Changes in The Small Grain Areas

Mechanization proceeded rapidly in the small grain areas from 1915 to 1930. The fact that the acreage of crops in some parts of these areas increased did not wholly obscure the influence of new methods on labor used. Prior to 1930 production expanded mostly as a result of extending crop production on range lands. These areas are characterized by large farms, extensive cash-grain systems of farming, and a quite general use of power equipment.

The size of the farm enterprise, measured in terms of labor used on crops harvested and on livestock, increased from 82 percent of the 1924-29 average in 1909 to 104 in 1932. Crop failures have been so severe that the index has not exceeded 80 since 1936. During the years when agriculture was expanding total employment increased very slightly. More hired workers were reported for 1927 than for any other year, and then declined rapidly. Compared with numbers in the period 1924-29, practically the same number of family workers were reported in 1938, but only 77 percent as many hired workers. That is, average employment decreased by the equivalent of 50,000 workers. Because of the seasonal nature of harvest work more than 50,000 workers were affected.

The decreased labor requirements are due in part to drought and fewer acres for harvest, but so much is the result of the use of improved machinery that a restoration of the former volume of employment could not be expected even with favorable crop seasons.

Table 2. - Indexes of Size of Enterprise, Production, and Employment
1924-29 = 100 and Employment 1938 by Areas of the United States

Area	Size of enterprise	Agricultural production	Employment			
	Index	Index	Total labor	Hired labor	Total labor	Hired labor
			Index	Index	Thousands	Thousands
Corn	99	116	93	78	1,241	297
Eastern dairy	99	110	96	94	746	248
Western dairy	104	115	96	77	908	206
Eastern cotton	92	101	87	82	1,268	257
Delta cotton	97	116	96	95	1,238	213
Western cotton	79	84	88	85	1,101	253
Small grain	80	80	93	77	746	158
Middle eastern	94	103	101	88	1,876	343
Range	96	109	103	97	296	111
Northwestern	109	123	111	120	302	98
California	114	133	87	98	312	156
United States	93	104	94	86	10,745	2,529

Calculated to extend series given in, Trends in Size and
Production of the Aggregate Farm Enterprise 1909-36,
W.P.A., N.R.P., report A-6.

Combines Harvest Grain in All Important Producing Areas

The use of tractor power with adapted equipment has reduced the need for labor, particularly seasonally hired labor, in many sections of the United States. Of particular importance was the spread of the combined harvester-thresher through the important wheat producing areas. Practically all of the wheat in the hard winter wheat areas is now harvested with the combine. A very high percent of the wheat in the spring wheat areas is now combined. As a result of this equipment a crew of 2 or 3 men can now do the same work that was performed by a crew of 8 to 10 men and can do the work in less time. Probably 110,000 combines are now in use. 1/ It has been estimated that somewhere between 100,000 and 200,000 casual migrant laborers found employment in the wheat areas in 1920. 2/ This opportunity for employment has practically disappeared and the extra labor required at harvest is for the most part supplied from local sources.

Displacement of Labor on Wheat Farms

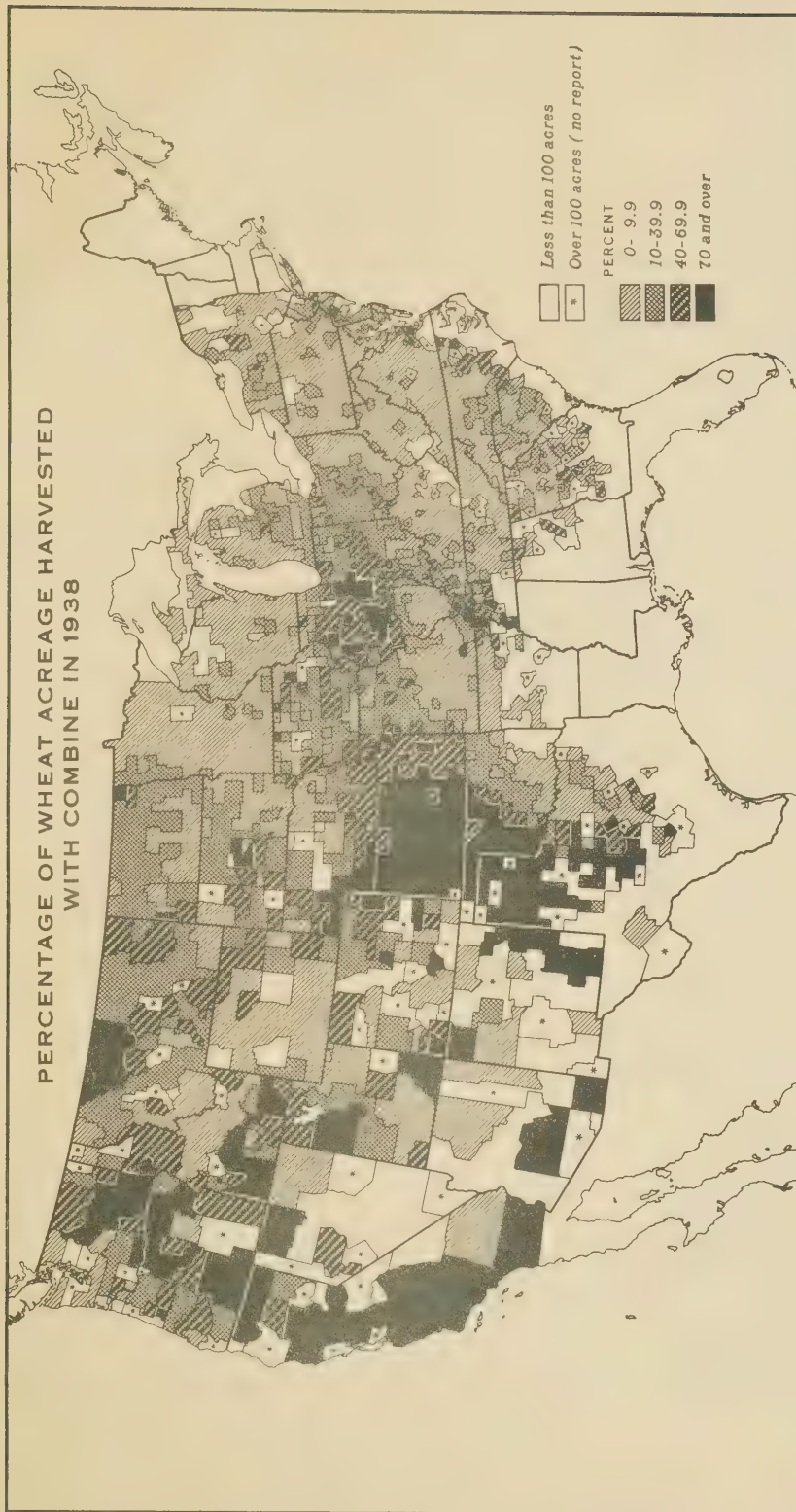
An illustration of the effects of the use of tractors and combined harvesters on the requirements of farm labor is shown by comparing the labor needs on a 320-acre Central Kansas farm in 1920 with the labor force needed with present equipment and practices. In 1920 this farm was operated by one man with the help of a son during the summer season and hired labor the equivalent of an additional man for approximately 90 days. With the equipment now in general use in the area only about 10 days of work would need to be hired, and probably this extra work would be obtained by exchanging labor with other farmers in the neighborhood.

Source of data: Labor needs adjusted from farm record in files of Division of Farm Management and Costs, Bureau of Agricultural Economics.

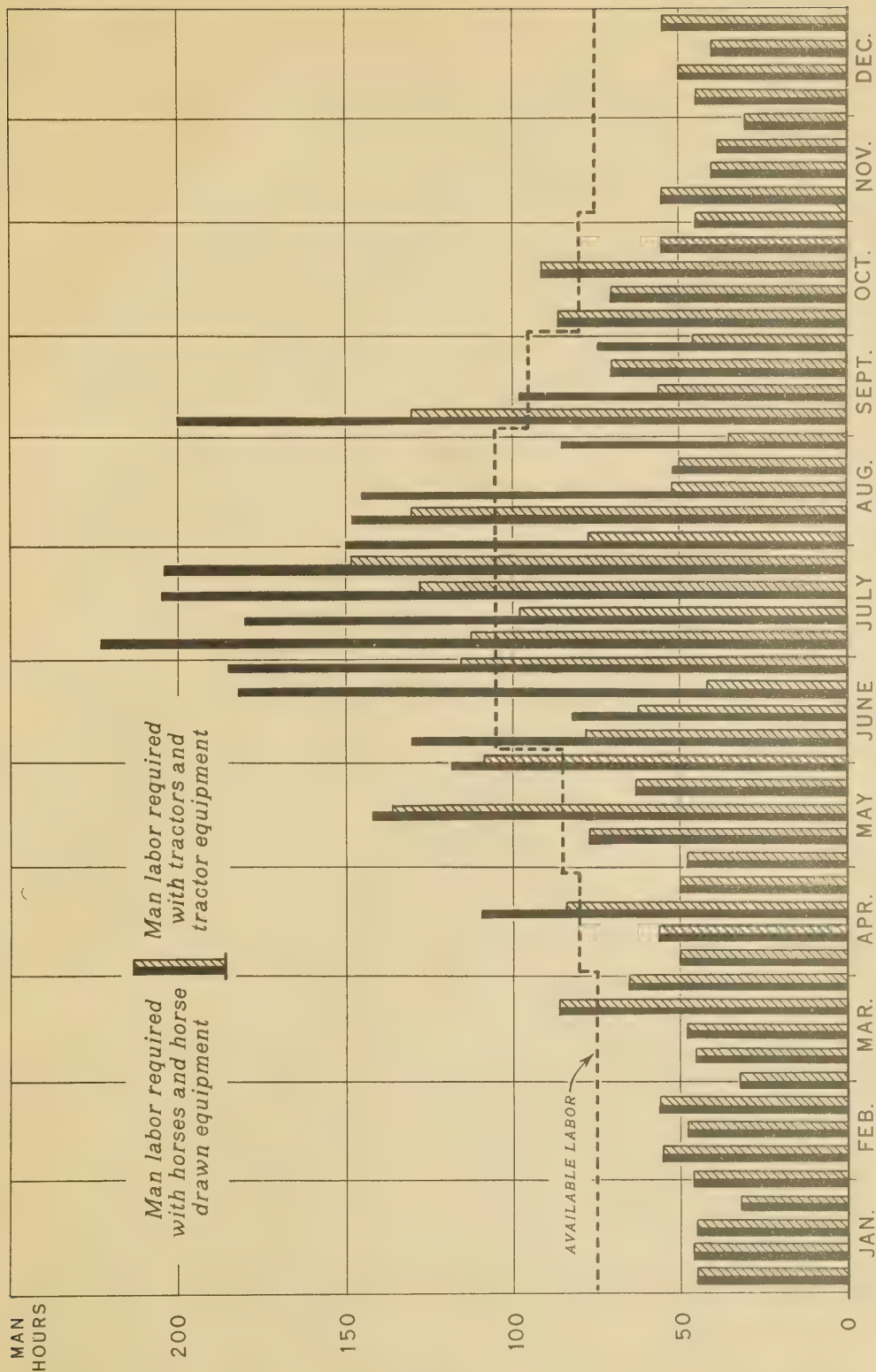
1/ Estimate, Implement and Tractor, July 8, 1939.

2/ U. S. Dent. Agric. Bul. 1020, Harvest Labor Problems in Wheat Belt, p. 24.

PERCENTAGE OF WHEAT ACREAGE HARVESTED WITH COMBINE IN 1938



LABOR ON A 320-ACRE CENTRAL KANSAS FARM, BY WEEKS



Changes in Labor Used in the Corn Belt

Developments in the Corn Belt have tended to decrease the need for both family and hired labor. Table 2 indicates that the size of the enterprise measured in terms of harvested crops and numbers of livestock decreased somewhat during the period of 1920 to 1930 and has remained at about or slightly below the 1924-29 level since 1930. Production in 1937, 1938, and 1939 was high but employment of hired workers has been only about 80 percent of employment during the base period. The average employment of family workers is reported at about the level of the base period. Probably an average of 59,000 fewer workers were hired in 1938 than in 1930.

The preponderance of family-sized farms and the development of labor saving machinery for use in peak labor operations, such as corn picking, would indicate that further decreases in hired labor in this area can be anticipated.

The Corn Picker Reduces Hired Labor Needs in the Corn Belt

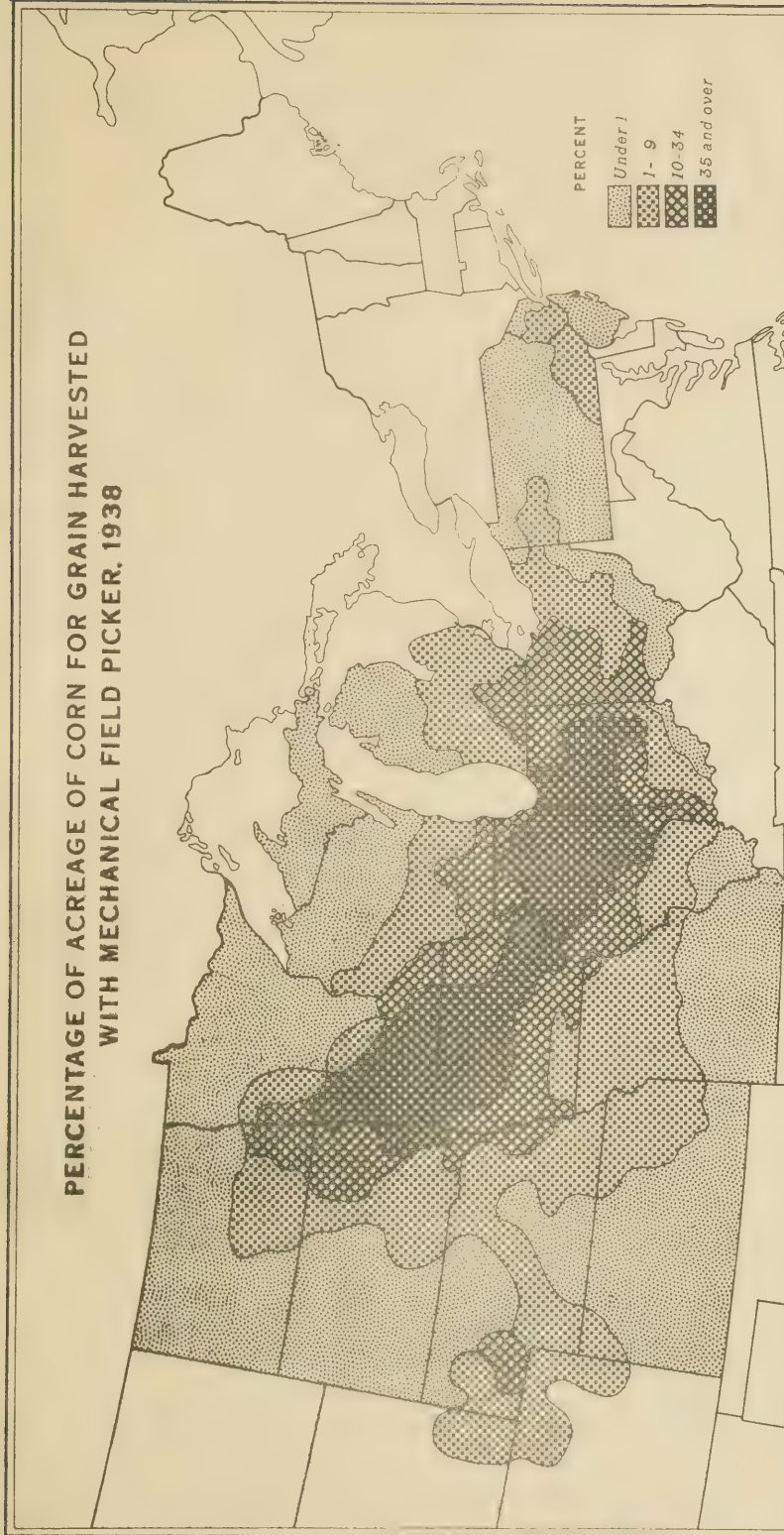
The use of the mechanical corn picker in the Corn Belt is eliminating the need for seasonal workers at corn picking time. The areas in which the mechanical field picker is used coincide with the areas in which hired workers found employment during the corn harvesting season. Although less than half of the corn even in the intensive corn producing areas was harvested with pickers in 1938, the use of pickers seems to be increasing and the opportunity for seasonal employment is lessened.

With a two-row picker and facilities for hauling and cribbing corn, yields of 60 to 70 bushels per acre can be harvested with only $1\frac{1}{2}$ to 2 man hours per acre. Hand picking and scooping would require about 9 man hours per acre to harvest a 70 bushel yield. 1/

For the United States as a whole the increased use of labor-saving equipment offers an explanation for the lessened requirements for hired labor. Introduction of new equipment in the corn area, in the western dairy area, and in the small grain area coincides with reductions in the use of hired workers.

1/ U.S.D.A., Farmers Bul. 1816, Mechanizing the Corn Harvest.

PERCENTAGE OF ACREAGE OF CORN FOR GRAIN HARVESTED WITH MECHANICAL FIELD PICKER, 1938



Changes in Size and Number of Farms

The census shows in broad outlines the change in sizes of farms in the United States. The number of farms reported in 1935 (6,812,000) was 364,000 greater than the number reported in 1920. Most of this increase was accounted for by the number of farms which were smaller than 10 acres. The increase in farms smaller than 20 acres, 457,000, was greater than the increase in all farms. An increase in the number of farms larger than 175 acres and a decrease in the size groups between 20 and 174 acres suggests a shift from the modal size to both extremes.

Selected areas in which the influences of mechanization may be noted indicate a shift from large farms in the spring wheat areas and an increase in 160 acre farms. In the cash corn area the shift was from 160 acre farms to larger or smaller farms. In the older cotton area the total number of farms decreased and the changes in farm size may be due to new systems of farming, but the tendency was definitely toward larger farms. The contrary development in the western cotton area increased the number of farms and apparently led to smaller farms. This change reflects a change in type of farming which gives more emphasis to cotton. The marked change in the northwest wheat area was toward a higher proportion of very large or very small farms.

In most areas such as general farming or livestock producing areas the census reports indicate small changes. Drastic changes in size such as are expected in the newer wheat regions were encouraged by large scale machinery, but also were due to the adjustment of systems of farming to natural conditions.

Table 3.

Percent of Farms of Different Sizes in the
United States and in Selected Areas, 1920 and 1935

Area and Year	Farm	Size of Farm						
		Less	20 to	50 to	100 to	175 to	260 to	500 acres
		than 20:	49	99	174	259	499	and
		acres	acres	acres	acres	acres	acres	larger
	Thousands:	Percent:	Percent:	Percent:	Percent:	Percent:	Percent:	Percent:
United States								
1920	6,448	12.4	23.3	22.9	22.5	8.2	7.4	3.3
1935	6,812	18.4	21.1	21.2	20.6	7.9	6.9	3.8
Spring Wheat 1/								
1920	5.8	.6	.5	1.2	11.7	7.2	46.3	32.5
1935	6.4	2.2	1.5	1.9	16.4	6.3	43.2	28.5
Western Winter								
Wheat 2/								
1920	2.7	.5	.6	1.3	8.3	6.5	39.3	43.5
1935	3.4	7.0	2.1	3.1	10.7	4.9	32.1	40.1
Cash Corn 3/								
1920	3.6	3.3	3.8	15.7	42.1	22.0	12.4	.7
1935	3.6	6.7	4.0	13.4	39.3	21.2	14.1	1.3
Livestock								
Corn 4/								
1920	6.4	8.3	20.4	39.1	17.2	8.0	.6	-
1935	7.7	8.5	18.0	38.1	17.5	9.6	.6	-
Piedmont 5/								
1920	6.9	10.2	38.6	27.2	15.9	4.6	2.5	1.0
1935	5.5	12.0	38.0	25.8	21.3	6.7	4.6	1.6
West Cotton 6/								
1920	3.3	1.3	2.7	9.1	52.2	10.3	18.4	6.0
1935	5.1	5.4	6.0	10.1	42.9	11.7	19.4	4.5
Northwest								
Wheat 7/								
1920	3.4	4.7	4.1	4.4	14.0	10.7	30.8	33.3
1935	3.1	11.1	4.8	4.3	9.6	8.4	23.8	38.0

Data from U. S. Census

- 1/ Grand Forks and Morton Cos., N. Dak. and Spink Co., S. Dak.
- 2/ Ford and Thomas Cos., Kansas, Swisher Co., Texas.
- 3/ Douglas Co., Illinois, Pocahontas Co., Iowa.
- 4/ Hancock Co., Ill., Iowa County, Iowa.
- 5/ Greene Co., Georgia and Tallapoosa County, Alabama.
- 6/ Lubbock Co., Texas and Tillman Co., Oklahoma.
- 7/ Sherman Co., Oregon and Whitman Co., Washington.

Table 4.

Acreage of All Crops Per Farm in Selected Areas
1909, 1919, 1929, and 1936

Area		Acreage of All Crops per Farm			
		1909	1919	1929	1936
Hard winter wheat, Western	1/	442	451	496	550
Hard winter wheat, Eastern	2/	157	200	215	225
Wheat, Northwestern	3/	598	743	799	925
Hard spring wheat, Eastern	4/	315	353	358	333
Corn, livestock feeding	5/	110	133	132	135
Eastern Corn Belt	6/	82	92	93	92
Corn, cash grain	7/	175	176	176	190
Dairy, Eastern	8/	69	68	63	66
Dairy, Western	9/	91	87	90	91
Cotton, Piedmont	10/	57	59	54	46
Cotton, Mississippi Delta	11/	174	203	247	271
Cotton, Western	12/	132	159	200	200

Data from National Research Project, Works Progress Administration.

1/	Ford and Thomas Cos., Kansas; Swisher Co., Texas	Rept.A-10, p.108
2/	Phelps Co., Neb.; Garfield and Tillman Cos., Okla.	Rept.A-10, p.108
3/	Sherman Co., Ore.; Whitman Co., Wash.	Rept.A-10, p.108
4/	Grand Forks and Morton Cos., N.Dak.; Spink Co., S. Dak.	Rept.A-10, p.108
5/	Hancock Co., Ill.; Iowa Co., Iowa.	Rept.A- 5, p. 50
6/	Greene and Putnam Cos., Ohio; Clinton Co., Ind.	Rept.A- 5, p. 50
7/	Douglas Co., Ill.; Pocahontas Co., Iowa.	Rept.A- 5, p. 50
8/	Medina Co., Ohio; Lancaster Co., Pa.	Rept.A- 5, p. 82
9/	Steele Co., Minn.; Green and Waukesha Cos., Wis.	Rept.A- 5, p. 82
10/	Greene Co., Ga.; Tallapoosa, Ala.	Rept.A- 7, p.116
11/	Washington and Bolivar Cos., Miss.	Rept.A- 7, p.116
12/	Lubbock Co., Texas; Tillman Co., Okla.	Rept.A- 7, p.116

Mechanization Increases Size of Farms

On the basis of actual time requirements on crops one would expect some drastic adjustments to follow the introduction of machinery. In some instances these adjustments are made. In the wheat producing areas the tractor and combine stepped up the acreage that could be handled by one man and one unit of power and machinery from 200 to 250 acres to 500 to 800 acres. Rates of doing work were increased so that one man with less additional help than he formerly required could double his acreage. A study in the High Plains cotton area in Texas during the period of 1931 to 1937 shows for a group of 140 farmers for which information is available a pronounced shift from 1- and 2-row horse equipment to 2-row or larger tractor equipment. In seven years the proportion of farmers using tractors increased from 25 to 79 percent. Although only one farmer in 10 was using 3- or 4-row tractor equipment, 86 percent used 2-row or larger equipment exclusively. Adjustments in crop acreage to fit units of equipment were less pronounced than the tendency to select power units to operate the land under the control of one man. Table 4 shows the potential changes in farming assuming that certain units of equipment would be used. If mechanical cotton picking becomes practicable a more rapid shift in the direction of larger units might be forecast.

A study in Minnesota to learn the relation between tractor use and changes in farming indicated that in that State changes in size of farms were made slowly. In the cash grain areas 50 percent of the farmers with tractors said they increased the size of the farm after buying a tractor. In the dairy and livestock areas most farmers reported no change in the size of farm although about 25 percent of the farms did increase in size. In all areas about one-third of the farmers said tractors decreased the amount of hired labor, but in areas where farmers reported larger farms they reported an increase in hired labor also.

Conclusions from a brief study in Pennsylvania were that few farmers increase their crop acreage as a result of substituting tractors for horses. On the other hand, reports from Virginia indicated that some farms were enlarged as they were mechanized.

Table 5. Number of Operating Units Necessary Assuming
 Various Levels of Operating Efficiency

Equipment	Average acreage : Number of farms necessary for		
	of cropland per : the operation of the crop acre-		
	farm : age in five main counties		
	: Percentage of number		
		Number	of farms in 1934
One-row horse drawn	: 100	: 15,260	: 146
Two-row horse drawn	: 180	: 8,480	: 81
Two-row tractor drawn	: 250	: 6,100	: 58
Four-row tractor drawn	: 450	: 3,346	: 33
Average of all farms	:	:	:
(1935 Census)	: 167	: 10,421	: 100

Bonnen, C. A. and Magee, A. C. Some Technological Changes in the
 High Plains Cotton Area of Texas, *Journal of Farm Economics*, Vol. XX,
 No. 3, August 1938, p. 612

THE INFLUENCE OF MECHANIZATION ON FARM EMPLOYMENT

Mechanization in the wheat producing areas and in the Corn Belt has been accompanied by a persistent, if slowly working tendency to increase the average size of farm. The tendency is a very natural consequence of the use of power and equipment which enables one man to prepare land, seed and harvest an acreage for crops greater than he could handle with horse power. As the typical family farm increased its acreage other farms had to be reduced in size and still others were absorbed in the enlarging process.

The adjustment process, although it is too recent in most sections of the United States for the final agricultural pattern to be clearly evident, seems pointed toward fewer and more highly commercialized farms in the commercial farming areas and more noncommercial farms in areas of low productivity.

The availability of the recently developed small tractor may arrest the movement toward consolidation and enlargement of farms in certain areas where the size of unit is large enough to permit economic use of the new power unit. However, the smaller power unit may set in motion the forces toward agricultural reorganization in regions not yet touched by the influence of mechanization.

The adaptability of the all-purpose tractor and the need for adequate power on the heavy and more fertile soils has already initiated some significant developments in plantation reorganization in the South. Mechanization in the South has lagged behind other regions partly because of the need for hand labor in the cotton chopping and picking operations, and partly because the cropper system did not lend itself to the use of mechanical power. The past few years have brought a change from horse to tractor power and with it a shift from share-cropper to hired labor in some Southern areas. Displacement of families is one phase of the current reorganization.

Some families left the land and others were placed on a hired labor basis. Employment practices are not uniform between areas, but in one plantation area the proportion of the crop acreage handled by share-tenants had decreased from 1933 to 1936 from 13 to 6 percent, the acreage handled by share-croppers decreased from 55 to 42 percent and the acreage handled by wage workers increased from 30 to 53 percent.

This change of status cannot be attributed flatly to either a reduction of cotton acreage or to mechanization. Regardless of whether tractors or mules are used the prices of cotton, wages of cotton laborers, and alternatives for workers tended to increase the acreage of "wage cotton". Through the period 1933 to 1936 the income advantage was in favor of the wage cotton system. A recent Department publication, U.S.D.A. Technical Bulletin No. 682 states, "A continuation of the income advantage of using wage labor probably will result in an increase in wage operations -- particularly if additional economies can be achieved through the use of wage labor in conjunction with large scale machinery".

Mechanization is one contributing factor to the adjustment in organization and size of units. Similar trends are shown by areas regardless of the extent of power changes and it is therefore difficult to isolate and measure the influence of the tractor alone. A study made in a number of Arkansas areas suggests that with the plantation organization, one tractor would permit the elimination of two worker families.

Similar conclusions regarding the effect of mechanization on labor in the cotton areas are drawn from estimates of the number of families required to operate a plantation of 750 crop acres in the Mississippi Delta. These are for a system of:

- (1) Mule power only, grain purchased, all work done with resident share-croppers - 40 families.
- (2) Mule power only, grain produced, all work done with share-croppers - 34 families.
- (3) Tractor power, wage labor maintained on the plantation to do work prior to harvest - 24 families.

So long as cotton must be picked by hand the need for harvest labor will prevent complete displacement of cotton workers, yet tractor use will reduce the need for many resident workers in the South. The rate of family displacement would undoubtedly be lower in other areas than in those areas where the plantation organization prevails, and in some of the rougher areas mechanization will necessarily proceed slowly, yet it is not unreasonable to assume that within the next decade the tractors used in the South will nearly double and that as a result as many as 300,000 families now living on farms will be displaced and that more will assume the status of hired workers.

Outside of the cotton producing areas, the trend to greater mechanization would continue the present tendency to reduce the labor used on farms, and increase the acreages per farm in commercial agricultural areas. The use of small tractors should have the effect of stabilizing the size of farm with no revolutionary change in size in some general farming areas. However, adjustments are still to be made in areas mechanized during the past 10 years (except in the wheat and fruit producing areas where adjustments are fairly complete) and a continuation of farmer displacement and further reduction of labor can be expected.

The reported employment in agriculture indicates that the average number of workers for the year was 544,000 less in 1939 than in 1930. The average number of hired workers for the year was 371,000 less in 1939 than in 1930. Some part of this displacement was due to the severe drought over large areas of the Plains States but much was the result of changed methods of production and changes in systems of farming. The influence of technical change probably will continue to be felt in agriculture and a conservative estimate would place the number of workers to be displaced during the next decade at a figure only slightly below that of the past 10 years. Even with no new developments, and barring a wage level so low that the trend to mechanization would be retarded, the displacement of 350,000 to 400,000 workers in agriculture may be anticipated.

FARM EMPLOYMENT: AVERAGE ANNUAL NUMBER OF PERSONS
EMPLOYED IN THE UNITED STATES, 1930-39

